Ordering number : EN4786

Monolithic Linear IC



No. 4786

LA5609

Multi-Function Voltage Regulator for Radio Cassette Recorders with CD Player

Overview

The LA5609 is a multi-function multi-voltage power supply that includes a built-in on/off function. The LA5609 provides dedicated outputs for motors, audio systems, CD drive, radio, microprocessor, and loading drives, thus making it optimal for use as the system power supply in radio cassette recorders with CD player.

Functions

- Power supply systems for radio cassette recorders with CD player
- Miniature electronic equipment
- Low-saturation regulator (14.5 V/1.2 A, 9 V/300 mA, 7.5 V/800 mA)
- High-precision power supply (two 5 V/220 mA systems, 5 V/100 mA, 8 V/800 mA)
- Limiter power supply (9 V/60 mA)

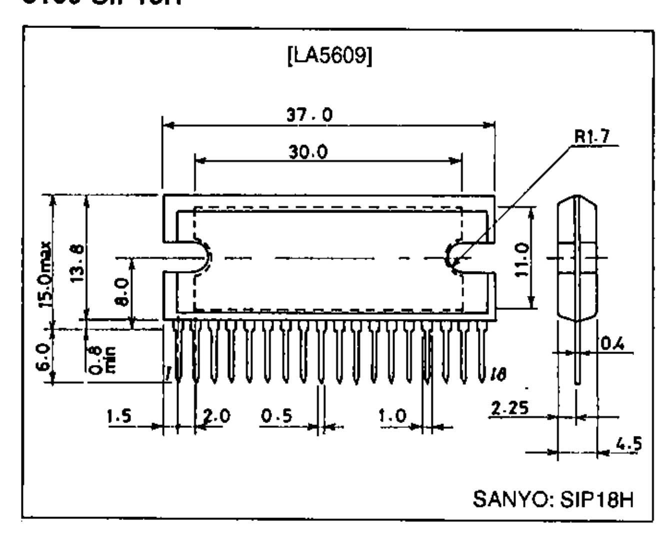
Features

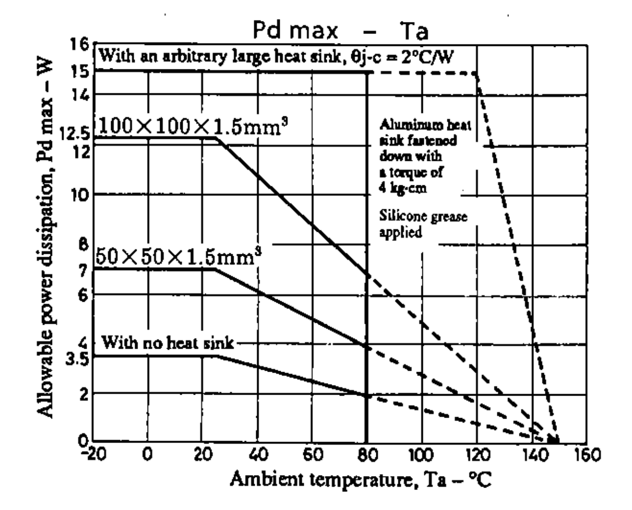
- Supports end-product miniaturization by the provision of built-in control circuits.
- Provides reduced internal power dissipation by the adoption of a low-saturation regulator.
- Built-in output current limiter prevents IC destruction due to output shorts.

Package Dimensions

unit: mm

3109-SIP18H





Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{CC} max		24	V
V_{REF} pin voltage	V_{REF}		6	V
POWER CONT pin voltage	V_{CONT} max		6	V
AC STBY pin voltage	V_{AC} max		6	V
MODE SW pin voltage	V_{MODE} max		6	V
Allowable power dissipation	Pd max	With no heat sink	3.5	W
Operating temperature	Topr		–20 to +80	°C
Storage temperature	Tstg		–55 to +150	°C

Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{CC}		6.5 to 22	V
Input voltage	V_{REF}		4.5 to 5.5	V
Motor 14.5 V output current	$I_{O\ MOT}$		0 to 1.2	A
Audio 9 V output current	$I_{O\ AUD}$		0 to 300	mA
Digital 5 V output current	$I_{O\ DIGI}$		0 to 220	mA
CD 5 V output current	$I_{O\ CD5}$		0 to 220	mA
CD 8 V output current	$I_{O\ CD8}$		0 to 0.8	A
Radio 5 V output current	$I_{O\ RAD}$		0 to 100	mA
Loading 7.5 V output current	$I_{O\ LOAD}$		0 to 0.8	A
9 V limiter output current	$I_{O\ LIM}$		0 to 60	mA

Operating Characteristics at Ta = 25°C in the specified test circuit

Parameter	Symbol	Conditions	min	typ	max	Unit
[No Load Currents]						
V_{CC} quiescent current	I_{CC}	V_{CC} = 12 V, Power cont.: L, 5 V_{REF}: L			500	µA
Influx 1 V_{REF} 5 V input current	I_{REF1}	V_{CC} = 0 V, Power cont.: L			10	µA
Influx 2 V_{REF} 5 V input current	I_{REF2}	V_{CC} = 12 V, Power cont. = 5 V			700	µA
[Motor 14.5 V Regulator Block] V_{CC} = 16 V, $I_{O\ MOT}$ = 1.2 A, Power cont. = 5 V						
Output voltage	$V_{O\ MOT}$		14.0	14.5	15.0	V
Dropout voltage	$V_{DROP\text{-}MOT}$	V_{CC} = 14 V, $I_{O\ MOT}$ = 600 mA		0.4	0.8	V
Line regulation	$\Delta V_{OLN\text{-}MOT}$	V_{CC} = 16 to 22 V		30	300	mV
Load regulation	$\Delta V_{OLD\text{-}MOT}$	$I_{O\ MOT}$ = 0 to 1.2 A		200	800	mV
Peak output current	$I_{OP\text{-}MOT}$		1.2			A
Short circuit output current	$I_{OSC\text{-}MOT}$			300		mA
[Audio 9 V Regulator Block] V_{CC} = 11 V, $I_{O\ AUD}$ = 300 mA, Power cont. = 5 V						
Output voltage	$V_{O\ AUD}$		8.5	9.0	9.5	V
Dropout voltage	$V_{DROP\text{-}AUD}$	V_{CC} = 8.5 V, $I_{O\ AUD}$ = 150 mA		0.2	0.8	V
Line regulation	$\Delta V_{OLN\text{-}AUD}$	V_{CC} = 11 to 22 V		100	400	mV
Load regulation	$\Delta V_{OLD\text{-}AUD}$	$I_{O\ AUD}$ = 0 to 300 mA		100	400	mV
Peak output current	$I_{OP\text{-}AUD}$		300			mA
Short circuit output current	$I_{OSC\text{-}AUD}$			50		mA
Ripple rejection	$R_{REJ\text{-}AUD}$	f = 120 Hz, 10 V ≤ V_{CC} ≤ 15 V, C = 1 µF		60		dB

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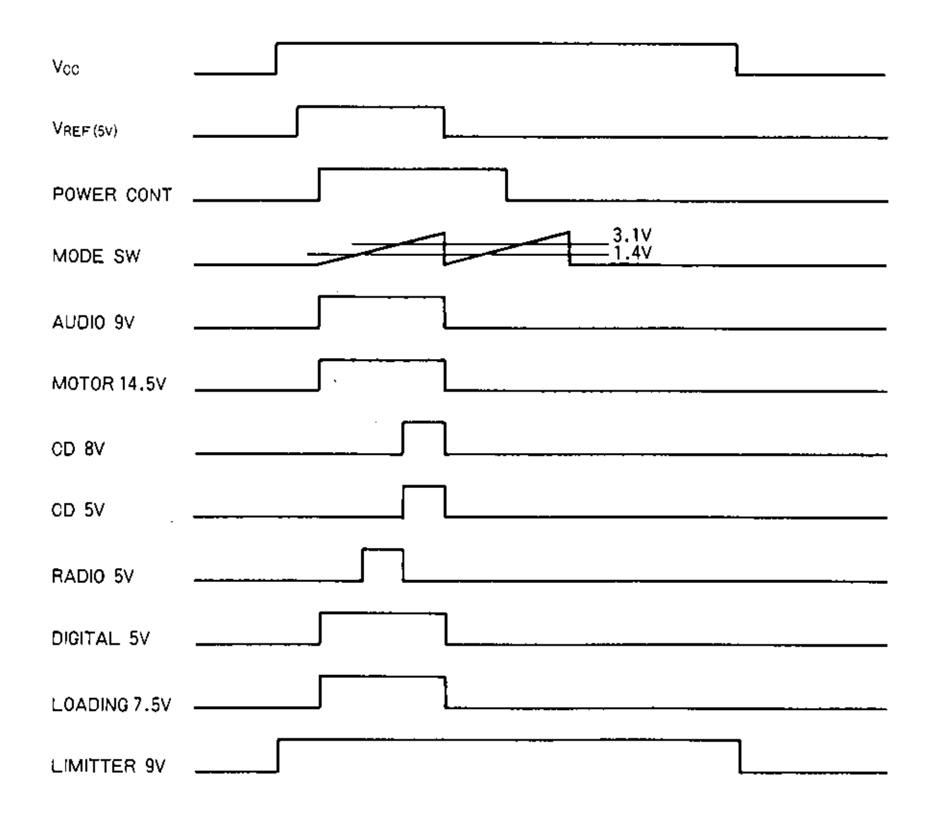
Parameter	Symbol	Conditions	min	typ	max	Unit
[Digital 5.0 V Regulator Block] Power cont. = 5 V						
Output voltage	$V_{O\ DIGI}$	V_{CC} = 16 V, $I_{O\ DIGI}$ = 100 mA	4.95	5.05	5.15	V
Dropout voltage	$V_{DROP\text{-}DIGI}$	V_{CC} = 4.9 V, $I_{O\ DIGI}$ = 110 mA		0.6	1.4	V
Line regulation	$\Delta V_{OLN1\text{-}DIGI}$	V_{CC} = 16 to 20 V, $I_{O\ DIGI}$ = 220 mA	0	40	60	mV
	$\Delta V_{OLN2\text{-}DIGI}$	V_{CC} = 16 to 8 V, $I_{O\ DIGI}$ = 220 mA	–100	–70	0	mV
	$\Delta V_{OLN3\text{-}DIGI}$	V_{CC} = 16 to 20 V, $I_{O\ DIGI}$ = 0 mA	–20	0	+20	mV
	$\Delta V_{OLN4\text{-}DIGI}$	V_{CC} = 16 to 8 V, $I_{O\ DIGI}$ = 0 mA	–20	0	+20	mV
Load regulation	$\Delta V_{OLD1\text{-}DIGI}$	V_{CC} = 16 V, $I_{O\ DIGI}$ = 100 to 220 mA	0	40	60	mV
	$\Delta V_{OLD2\text{-}DIGI}$	V_{CC} = 16 V, $I_{O\ DIGI}$ = 100 to 0 mA	–60	–40	0	mV
Peak output current	$I_{OP\text{-}DIGI}$	V_{CC} = 6.5 V	220	260		mA
Short circuit output current	$I_{OSC\text{-}DIGI}$	V_{CC} = 6.5 V		260		mA
[CD 5.0 V Regulator Block] Power cont. = 5 V, Mode SW = 5 V						
Output voltage	$V_{O\ CD5}$	V_{CC} = 16 V, $I_{O\ CD5}$ = 100 mA	4.9	5.0	5.1	V
Dropout voltage	$V_{DROP\text{-}CD5}$	V_{CC} = 4.9 V, $I_{O\ CD5}$ = 110 mA		0.6	1.4	V
Line regulation	$\Delta V_{OLN1\text{-}CD5}$	V_{CC} = 16 to 20 V, $I_{O\ CD5}$ = 220 mA	0	40	60	mV
	$\Delta V_{OLN2\text{-}CD5}$	V_{CC} = 16 to 8 V, $I_{O\ CD5}$ = 220 mA	–100	–70	0	mV
	$\Delta V_{OLN3\text{-}CD5}$	V_{CC} = 16 to 20 V, $I_{O\ CD5}$ = 0 mA	–20	0	+20	mV
	$\Delta V_{OLN4\text{-}CD5}$	V_{CC} = 16 to 8 V, $I_{O\ CD5}$ = 0 mA	–20	0	+20	mV
Load regulation	$\Delta V_{OLD1\text{-}CD5}$	V_{CC} = 16 V, $I_{O\ CD5}$ = 100 to 220 mA	0	40	60	mV
	$\Delta V_{OLD2\text{-}CD5}$	V_{CC} = 16 V, $I_{O\ CD5}$ = 100 to 0 mA	–60	–40	0	mV
Peak output current	$I_{OP\text{-}CD5}$	V_{CC} = 6.5 V	220	260		mA
Short circuit output current	$I_{OSC\text{-}CD5}$	V_{CC} = 6.5 V		260		mA
[CD 8.0 V Regulator Block] V_{CC} = 9.5 V, $I_{O\ CD8}$ = 800 mA, Power cont. = 5 V, Mode SW = 5 V						
Output voltage	$V_{O\ CD8}$		7.5	8.0	8.5	V
Dropout voltage	$V_{DROP\text{-}CD8}$	V_{CC} = 7.5 V, $I_{O\ CD8}$ = 400 mA		0.6	1.4	V
Line regulation	$\Delta V_{OLN\text{-}CD8}$	V_{CC} = 9.5 to 22 V		20	200	mV
Load regulation	$\Delta V_{OLD\text{-}CD8}$	$I_{O\ CD8}$ = 0 to 800 mA		100	250	mV
Peak output current	$I_{OP\text{-}CD8}$		0.8	1.1		A
[Radio 5.0 V Regulator Block] Power cont. = 5 V						
Output voltage	$V_{O\ RAD}$	V_{CC} = 16 V, $I_{O\ RAD}$ = 50 mA	4.9	5.0	5.1	V
Dropout voltage	$V_{DROP\text{-}RAD}$	V_{CC} = 4.9 V, $I_{O\ RAD}$ = 50 mA		0.6	1.4	V
Line regulation	$\Delta V_{OLN1\text{-}RAD}$	V_{CC} = 16 to 20 V, $I_{O\ RAD}$ = 100 mA	0	20	40	mV
	$\Delta V_{OLN2\text{-}RAD}$	V_{CC} = 16 to 8 V, $I_{O\ RAD}$ = 100 mA	–70	–40	0	mV
	$\Delta V_{OLN3\text{-}RAD}$	V_{CC} = 16 to 20 V, $I_{O\ RAD}$ = 0 mA	–10	0	+10	mV
	$\Delta V_{OLN4\text{-}RAD}$	V_{CC} = 16 to 8 V, $I_{O\ RAD}$ = 0 mA	–10	0	+10	mV
Load regulation	$\Delta V_{OLD1\text{-}RAD}$	V_{CC} = 16 V, $I_{O\ RAD}$ = 50 to 100 mA	0	20	40	mV
	$\Delta V_{OLD2\text{-}RAD}$	V_{CC} = 16 V, $I_{O\ RAD}$ = 50 to 0 mA	–40	–20	0	mV
Peak output current	$I_{OP\text{-}RAD}$	V_{CC} = 6.5 V	100	160		mA
Short circuit output current	$I_{OSC\text{-}RAD}$	V_{CC} = 6.5 V		160		mA
[Loading 7.5 V Regulator Block] Power cont. = 5 V						
REG SET voltage	V_{REGS}	V_{CC} = 16 V, $I_{O\ LOAD}$ = 400 mA	1.27	1.31	1.35	V
Dropout voltage	$V_{DROP\text{-}LOAD}$	V_{CC} = 7.3 V, $I_{O\ LOAD}$ = 400 mA		0.4	0.8	V
Line regulation	$\Delta V_{OLN1\text{-}LOAD}$	V_{CC} = 16 to 20 V, $I_{O\ LOAD}$ = 800 mA	0	10	20	mV
	$\Delta V_{OLN2\text{-}LOAD}$	V_{CC} = 16 to 9 V, $I_{O\ LOAD}$ = 800 mA	–20	–10	0	mV
	$\Delta V_{OLN3\text{-}LOAD}$	V_{CC} = 16 to 20 V, $I_{O\ LOAD}$ = 0 mA	–10	0	+10	mV
	$\Delta V_{OLN4\text{-}LOAD}$	V_{CC} = 16 to 9 V, $I_{O\ LOAD}$ = 0 mA	–10	0	+10	mV
Load regulation	$\Delta V_{OLD1\text{-}LOAD}$	V_{CC} = 16 V, $I_{O\ LOAD}$ = 400 to 800 mA	0	10	20	mV
	$\Delta V_{OLD2\text{-}LOAD}$	V_{CC} = 16 V, $I_{O\ LOAD}$ = 400 to 0 mA	–20	–10	0	mV
Peak output current	$I_{OP\text{-}LOAD}$	V_{CC} = 9 V	0.8			A
Short circuit output current	$I_{OSC\text{-}LOAD}$	V_{CC} = 9 V		200		mA

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Parameter	Symbol	Conditions	min	typ	max	Unit
[9.0 V Limiter Block] V_{CC} = 11 V, $I_{O\ LIM}$ = 60 mA						
Output voltage	$V_{O\ LIM}$		8.0	9.0	9.5	V
Dropout voltage	$V_{DROP\text{-}LIM}$	V_{CC} = 8 V		1.0		V
Peak output current	$I_{OP\text{-}LIM}$		60	150		mA
Short circuit output current	$I_{OSC\text{-}LIM}$			200		mA
[Mode Switch] V_{CC} = 12 V						
Voltage with radio mode on	$V_{MTH\ H}$	Voltage when the radio output is switched high	1.1	1.4	1.7	V
Voltage with radio mode off	$V_{MTH\ L}$	Voltage when the radio output is switched low	2.9	3.1	3.3	V
Voltage with CD mode on	$V_{RTH\ H}$	Voltage when the CD 5 V and CD 8 V are switched high	2.9	3.1	3.3	V
Input impedance	Z_i		16.8	24	31.2	kΩ
[Power Control] V_{CC} = 12 V						
Output on control voltage	$V_{I\ CONT\text{-}ON}$		3.0			V
Output off control voltage	$V_{I\ CONT\text{-}OFF}$				2.0	V
[AC standby]						
Output on control voltage	$V_{I\ AC\text{-}ON}$		2.0			V
Output off control voltage	$V_{I\ AC\text{-}OFF}$				1.0	V
[5 V System Regulator Block] V_{CC} = 16 V, $I_{O\ DIGI}$ = $I_{O\ CD5}$ = 100 mA, $I_{O\ RAD}$ = 50 mA						
Difference between output voltages	ΔV_{DEF}			0	0.15	V

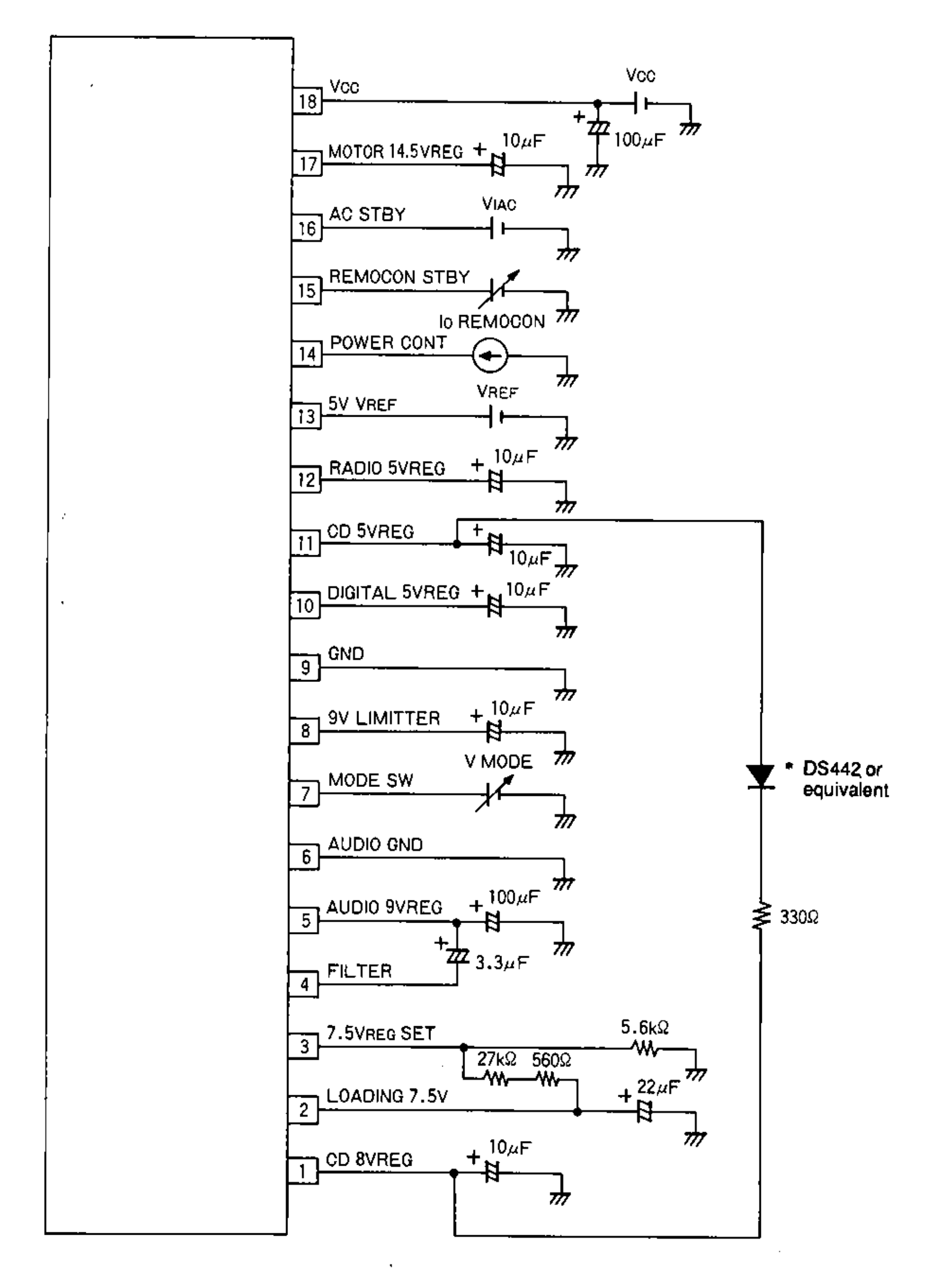
Timing Chart



Function Table

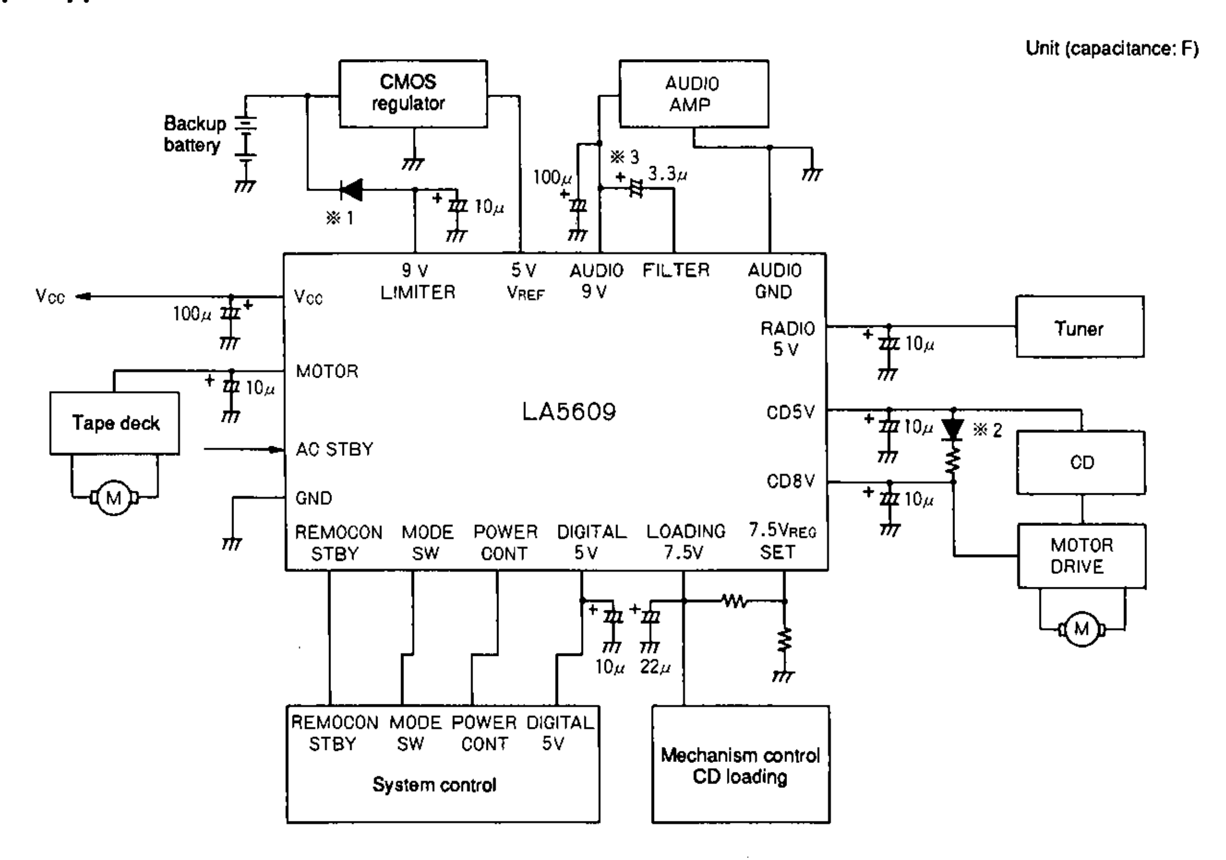
<table>
<tr><th rowspan="2">V_{REF}</th><th rowspan="2">Power cont.</th><th rowspan="2">Mode SW</th><th colspan="7">V_{OUT}</th></tr>
<tr><th>Audio 9 V</th><th>Motor 14.5 V</th><th>Digital 5 V</th><th>Loading 7.5 V</th><th>CD 8 V/ CD 5 V</th><th>Radio 5 V</th><th>Limitter 9 V</th></tr>
<tr><td rowspan="6">L</td><td rowspan="3">L</td><td>L (0 V)</td><td colspan="4">L</td><td>L</td><td>L</td><td>H</td></tr>
<tr><td>M (2.5 V)</td><td colspan="4">L</td><td>L</td><td>L</td><td>H</td></tr>
<tr><td>H (5 V)</td><td colspan="4">L</td><td>L</td><td>L</td><td>H</td></tr>
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<tr><td>H (5 V)</td><td colspan="4">H</td><td>H</td><td>L</td><td>H</td></tr>
</table>

Test Circuit



Note: * This diode is required for bringing up the CD 8 V regulator.

Sample Application Circuit



Note: 1. The diode in the 9 V limiter block must be added. It is required for preventing current from flowing into the 9 V limiter from the backup battery when V_{CC} is off.

2. The diode and resistor between the CD 5 V and CD 8 V blocks must be added. It is required to bring up the CD 8 V regulator.
3. External noise can be limited and ripple rejection can be improved by adding an electrolytic capacitor between the audio 9 V and the filter circuits.
4. The electrolytic capacitors between V_{CC} and GND and between each V0 and GND should have capacitances at least those shown in the diagram. Use Sanyo HW Series aluminum electrolytic capacitors or equivalent products.

Equivalent Circuit Block Diagram

Unit (resistance: Ω)

